

2.4 INFORMATION MODELING, METADATA, AND INFORMATION EXCHANGE STANDARDS

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2.4.1 Introduction

2.4.1.1 Purpose

This section specifies the minimum information modeling, metadata, and information exchange standards the DoD will use to develop or upgrade integrated, interoperable systems that directly or indirectly support the Warfighter.

2.4.1.2 Scope

This section applies to activity models, data models, and data definitions used to define physical databases, and formatted messages used to exchange information among systems.

Security standards related to this section are in Section 2.6.2.4.

2.4.1.3 Background

An information model is a representation at one or more levels of abstraction of a set of real-world activities, products, and/or interfaces. Within the Information System (IS) domain, there are two basic types of models frequently created: activity and data.

Activity models are representations of mission area applications, composed of one or more related activities. Information required to support the mission area function is the primary product of each activity model. An activity model is also referred to as a function or process model.

Data models, developed from the information requirements documented in the activity model, define entities, their data elements and illustrate the interrelationships among the entities. The data model identifies the logical information requirements and metadata, which forms a basis for physical database schemata and standard data elements.

In order to provide an authoritative source for DoD data standards, the DoD created the Defense Data Dictionary System (DDDS). The DDDS, managed by DISA, is a DoD-wide central database that includes standard names and definitions for data entities and data elements (i.e., attributes). The DDDS server also provides password-protected access to DoD standard data models. The DDDS is used to collect individual data standards derived from the DoD data model (DDM) and to document content and format for data elements. A classified version of the DDDS, known as the Secure Intelligence Data Repository (SIDR), has been developed to support standardization of classified data elements and domains. System developers use these repositories as a primary source of data element standards.

Information exchange is accomplished for the most part by sending formatted messages. The definition and documentation of these exchange mechanisms are provided by various messaging standards. Each message standard provides a means to define message form and functions (i.e., transfer syntax), which includes the definition of the message elements that are contained in each message. The message fields, which are currently defined in the various message standards, are not necessarily mutually consistent, nor are they consistently based on any activity or data models either within a message system or across message systems. Newer techniques provide more direct exchange of data without the user following a rigid format. A model-based structure will eventually provide definitions which will be data element-based and will be compliant with the DoD data element standards established in accordance with the DoD Directive (DoDD) 8320.1, Data Administration, and associated DoD 8320.1 manuals.

Efficient execution of information exchange requirements (IERs) throughout the joint battlespace is key to evolving the DoD toward the ultimate goal of seamless information exchange. The primary component of this infrastructure is the Tactical Data Link (TDL), composed of message elements/messages and physical media. However, due to the diversity of Warfighter requirements, no single data link is applicable to every platform and weapon system.

Tactical Digital Information Links (TADILs), structured on bit-oriented message standards, evolved to meet critical real-time and near-real-time message requirements. The United States Message Text Format (USMTF), designed primarily for non-real-time exchange, is based on a character-oriented message format and is the standard for human-readable and machine-processable information exchange. The goal of TDLs, character-oriented/human-readable (USMTF messages), imagery, voice, and video standards is to provide a timely, integrated, and coherent picture for joint commanders and their operational forces.

Disparate data link message formats and communications media have resulted in late delivery of crucial battlefield information. This causes significant interoperability problems among the Commanders-in-Chief (CINCs), Services, Agencies (C/S/As), and allied nations. Currently, it is difficult to establish seamless information flow among diverse data link units. Future joint operations, such as ballistic missile defense and battlefield digitization, will place greater emphasis on the need for automated C4I functions. Tomorrow's battlefields will vastly increase the burden on networks.

2.4.2 Mandates

This subsection identifies the mandatory standards, profiles, and practices for information modeling, metadata, and information exchange standards.

2.4.2.1 Activity Model

Activity models are used to document/model the activities, processes, and data flows supporting the requirements of process improvement and system development activities. Prior to system development or major system update, an activity model is prepared to depict the mission area function to a level of detail sufficient to identify each entity in the data model that is involved in an activity. The activity model forms the basis for data model development or refinement. It is validated against the requirements and doctrine, and approved by the operational sponsor.

The mandated standard for activity modeling is:

- FIPS PUB 183, Integration Definition for Function Modeling (IDEF0), December 1993.

2.4.2.2 Data Model

Relational data models are used in software requirements analyses and design activities as a logical basis for physical data exchange and shared data structures, including message formats and schema for shared databases. The DoD Data Model (DDM) is a department-wide logical data model which provides the standard definition and use of specific data elements to the developers of all DoD systems. Command and control systems will incorporate applicable Command and Control (C2) Core Data Model (C2CDM) requirements. The C2CDM is a subset of the DDM.

Implementation of the DDM and C2CDM will be interpreted to mean that the DDM and C2CDM will serve as the logical database schema defining the names, representations, and relations of data within DoD systems. System developers comply by using this database schema as the basis of their own physical database schemas. Developers of new and existing systems will maintain traceability between their physical database schema and the DDM and C2CDM, as applicable, by registering the use of the data standards in the DDDS. Information regarding access to the DDM and C2CDM can be obtained from the DoD Data Administration World Wide Web home page at:

<http://www-datadmn.itsi.disa.mil/>

Adherence to the DDM will aid DoD agencies in becoming data interoperable among all information systems. The information requirements of a new or major system upgrade will be documented within a data model based on the DDM. New information requirements are submitted by DoD Components and approved by functional data stewards in accordance with DoD Manual 8320.1-M-1, DoD Data Standardization Procedures. These information requirements will be used to extend the DDM and C2CDM, as appropriate.

System engineering methodology internal to a system is unrestricted. The mandated standards for Data Modeling are:

- DoD Manual 8320.1-M-1, DoD Data Standardization Procedures, April 1998 (which mandates the use of the DDM).
- FIPS PUB 184, Integration Definition For Information Modeling (IDEF1X), December 1993.

2.4.2.3 DoD Data Definitions

The Defense Data Dictionary System (DDDS) is a central database that includes standard data entities, data elements, and provides access to DDM files from the DDDS server. The procedures for preparing and submitting data definitions and data models for standardization are covered in DoD Manual 8320.1-M-1. A classified version of the DDDS, Secure Intelligence Data Repository (SIDR), has been developed to support standardization of classified data elements and domains. System developers shall use these repositories as a primary source of data element standards.

The mandated standards for DoD Data Definitions are:

- DoD Manual 8320.1-M-1, DoD Data Standardization Procedures, April 1998.
- Defense Data Dictionary System (DDDS).
- Secure Intelligence Data Repository (SIDR).

2.4.2.3.1 DoD Date Standards

In order to ensure the unambiguous exchange of date data between systems before, during, and past the year 2000, database design and data modeling shall adhere to DoD date data standards. For external exchange of character dates between systems not using a standardized message or transaction format, the mandated standards are:

- Calendar Date: DDDS Counter ID # 195
Format: YYYYMMDD (8-digit contiguous)

Where: YYYY = year; MM = month; DD = day
(Also referenced in ISO 8601, ANSI X3.30, and FIPS 4-1)

- Ordinal Date: DDDS Counter ID # 165
Format: YYYYDDD (7-digit contiguous)
Where: YYYY = year; DDD = ordinal day within year
(Also referenced in ISO 8601)
- Year Date: DDDS Counter ID #166
Format: YYYY (4-digit contiguous)
Where: YYYY = year
(Also referenced in ISO 8601)

2.4.2.4 Information Exchange Standards

2.4.2.4.1 Information Exchange Standards Applicability

Information Exchange Standards refer to the exchange of information among mission area applications within the same system or among different systems. The scope of information exchange standards follows:

- A. The exchange of information among applications shall be based on the logical data models developed from identifying information requirements through activity models, where appropriate. The data model identifies the logical information requirements, which shall be developed into physical database schemata and standard data elements.
- B. The standard data elements shall be exchanged using the data management, data interchange, and distributed computing services of application platforms. (Refer to Section 2.2 for further guidance on these services.) The goal is to exchange information directly between information systems, subject to security classification considerations.

For purposes of clarification, Information Exchange Standards refer to the system or application-independent ability of data to be shared, whereas Data Interchange is system or application-specific. Hence, this section discusses information exchange standards as the generic ability of a system or application to share data. Interchange standards help form the DII Common Operating Environment (COE) ensuring the use of system or application formats which can share data. Key references include Section 2.2.2.2.1.3, for SQL standards in Data Management Services and Section 2.2.2.2.1.4 for Data Interchange Services.

In distributed databases, other types of data messaging may be used as long as they remain DDDS compliant.

2.4.2.4.2 Tactical Information Exchange Standards

The message standards below are joint/combined message standards that provide for the formatted transfer of information between systems. Although it must be recognized that the J-Series Family of TDLs and the USMTF Standards are not model-based and therefore do not meet the goals of standard information exchange, they must be recognized as existing standards. As more systems are developed using logical data models and standard data elements, these message standards must evolve to be data model-based if they are to continue to support joint automated systems. In distributed databases, other types of data messaging may be used as long as they remain DDDS compliant.

2.4.2.4.2.1 Bit-oriented Formatted Messages

The J-Series Family of TADILs allow information exchange using common data element structures and message formats which support time-critical information. They include Air Operations/Defense Maritime, Fire Support, and Maneuver Operations. These are the primary data links for exchange of bit-oriented information. The family consists of LINK 16, LINK 22, and the Joint Variable Message Format (VMF) and interoperability is achieved through use of J-Series family messages and data elements. The policy and management of this family is described in the Joint Tactical Data Link Management Plan (JTDLMP), dated 6 June 1996.

New message requirements shall use these messages and data elements or use the message construction hierarchy described in the JTDLMP. The mandated standards for information exchange are:

- MIL-STD-6016, Tactical Digital Information Link (TADIL) J Message Standard, 7 February 1997.
- STANAG 5516, Edition 1, Tactical Data Exchange - LINK 16, Ratified 15 January 1997.
- Joint Interoperability of Tactical Command and Control Systems Variable Message Format (VMF) Technical Interface Design Plan (Test Edition) Reissue 2, August 1996.

2.4.2.4.2.2 Character-based Formatted Messages

USMTF messages are jointly agreed, fixed-format, character-oriented messages that are human-readable and machine-processable. USMTFs are the mandatory standard for record messages when communicating with the Joint Staff, Combatant Commands, and Service Components. The mandated standard for USMTF Messages is:

- MIL-STD-6040, United States Message Text Format (USMTF), 1 January 1997.

Note: MIL-STD-6040 is published every January with an implementation in the following January.

2.4.3 Emerging Standards

The standards listed in this subsection are expected to be elevated to mandatory status when implementations of the standards mature.

2.4.3.1 Activity Modeling

The emerging standard for activity modeling is IEEE P1320.1, IDEF0 Function Modeling, currently under development by a working group of the Software Engineering Standards Committee of the IEEE Computer Society. The standard extends FIPS PUB 183 by specifying detailed syntax and semantics for the IDEF0 language. The IDEF0 language deals with the constructs, semantics and syntax of the function modeling. The IDEF0 language is used to produce a function model which is a structured representation of the functions of a system or environment, and the information and objects which interrelate those functions. The intent of the IEEE standard is not to significantly change the notation described in FIPS PUB 183 but rather to improve the definition of it.

2.4.3.2 Data Modeling

The emerging standards for data modeling are IDEF1X97, Conceptual Schema Modeling and the Unified Modeling Language (UML). These standards accommodate object-oriented methods (OOM):

IDEF1X97. IDEF1X97 is being developed by the IEEE IDEF1X Standards Working Group of the IEEE 1320.2 Standards Committee. The standard describes two styles of the IDEF1X model. The *key-style* is used to produce information models which represent the structure and semantics of data within an enterprise and is backward-compatible with the US Government's Federal Standard for IDEF1X, FIPS 184. The *identity-style* is a wholly new language which provides system designers and developers a robust set of modeling capabilities covering all static and many dynamic aspects of the emerging object model. This identity-style can, with suitable automation support, be used to develop a model which is an executable prototype of the target object-oriented system. The identity-style can be used in conjunction with emerging dynamic modeling techniques to produce full object-oriented models.

Unified Modeling Language (UML). UML (Rational Corp., Version 1.0, January 1997) is a language for specifying, constructing, visualizing, and documenting the artifacts of a software-intensive system. In an elaborative approach, developers develop models and increasingly add details until the model becomes the actual system being developed. The UML is being submitted to the Object Management Group (OMG) for adoption as an industry standard. Information may be obtained from the World Wide Web at:

<http://www.rational.com>

2.4.3.3 DoD Data Definitions

DISA Joint Interoperability and Engineering Organization (JIEO), in coordination with the Standards Coordinating Committee (SCC) and the Change Control Board (CCB), will develop the strategy/policy for migration from many tactical data link (bit-oriented) and character-oriented joint message standards to a minimal family of DoD 8320.1-compliant information exchange standards. A normalized unified data/message element dictionary will be developed based on normalized Data Model and associated data element standards. The dictionary will support both character and bit-oriented representation of the standard data and their domain values. Message standards will then establish the syntax for standard data packaging to support mission requirements (e.g., character or bit-oriented, fixed or variable format, etc.). The unified data dictionary will ensure that multiple representations are minimized and transformation algorithms are standardized. The Data Model basis for the data elements will ensure the information is normalized.

2.4.3.4 Information Exchange Standards

The emerging standards for information exchange are:

- Multi-functional Information Distribution System (MIDS). MIDS is a planned replacement for the Joint Tactical Information Distribution System (JTIDS). MIDS will provide secure jam-resistant communications, utilizing tactical digital data and voice. Message format standards for MIDS will not change from those of the JTIDS.
- STANAG 5522, Edition 1, Tactical Data Exchange - LINK 22 (Undated) is the Multinational Group (MG) agreed Configuration Management (CM) baseline document as of 15 September 1995. It is distributed as ADSIA(DLWG)-RCU-C-74-95.